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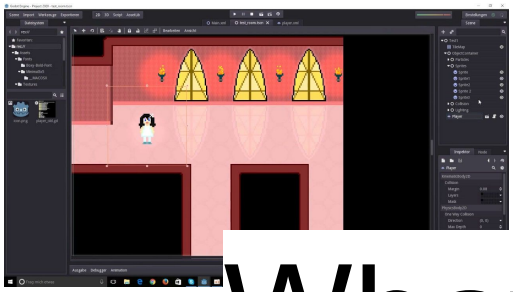
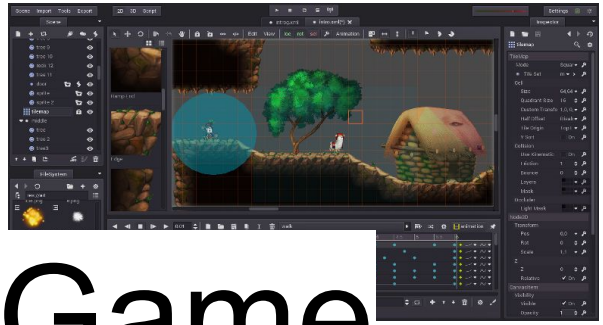
The following is a guest talk for Yale University's Amoriem Labs

https://amoriem-labs.github.io/

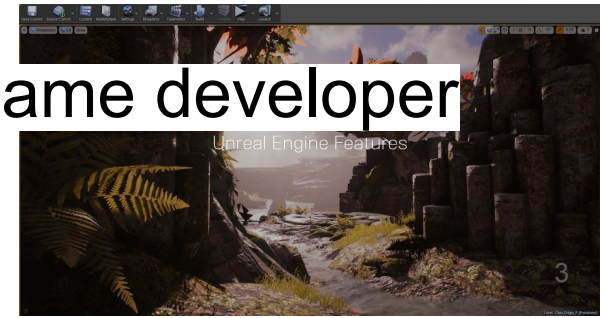




What goes into a Game during Game Development?

Dr. Mike Shah
http://www.mshah.io

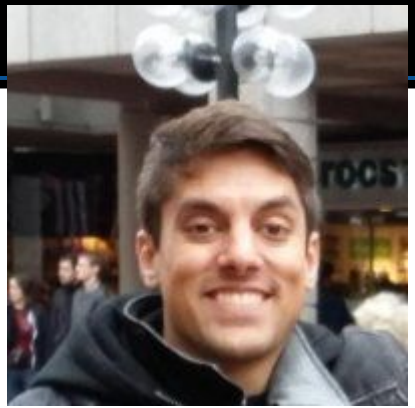
A presentation on roles and life as a game developer
November 17, 2024



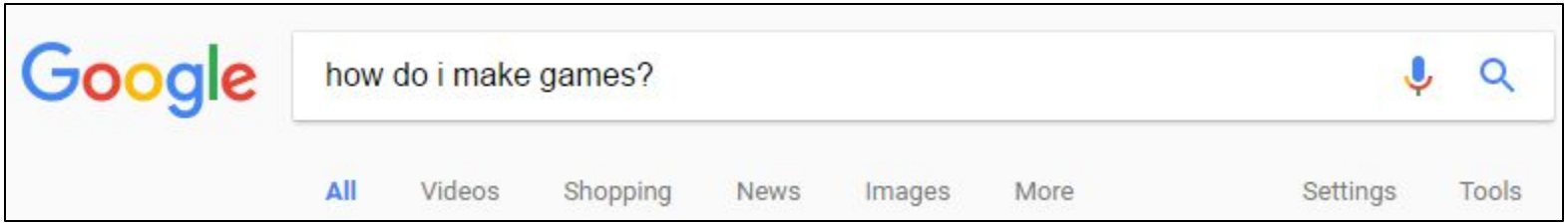
Goals Today

- Understand what goes into game development
  - Look at different roles and skills needed for different roles in the industry
    - Technical
    - Soft Skills
  - How to position yourself for a job in games (Simple -- build a portfolio)
    - See: https://www.youtube.com/watch?v=p8F2E2HatE4

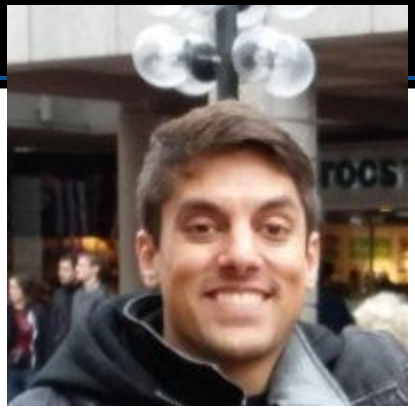
About Me (1/5)



(My Story)



About Me (2/5)



- I started writing video games around middle school.
- Shortly after I wrote programming tutorials for a gaming magazine.
- Went to undergraduate at The Ohio State University for Computer Science. Did quite a bit of research in gaming and medical visualization.
- Then wound up at Tufts to do my Masters and Ph.D. degree.
- Primarily interested in HCI, computer graphics and performance. That's also where my professional experience lies.

About Me (3/5)

4D Pipeline®
DEFINE ▮ DESIGN ▮ DEVELOP ▮ DEPLOY

intel®

Ohio Supercomputer Center

Tufts UNIVERSITY

THE OHIO STATE UNIVERSITY

NORTHEASTERN HUSKIES

Harvard Extension School
HARVARD DIVISION OF CONTINUING EDUCATION

BOSTON MEDICAL CENTER
EXCEPTIONAL CARE. WITHOUT EXCEPTION.

OREGON HEALTH & SCIENCE UNIVERSITY
OHSU

About M

Places where I worked on something “graphicsy” or performance related (all of them)

Ohio Supercomputer Center

Tufts UNIVERSITY

The Ohio State University

NORTHEASTERN HUSKIES

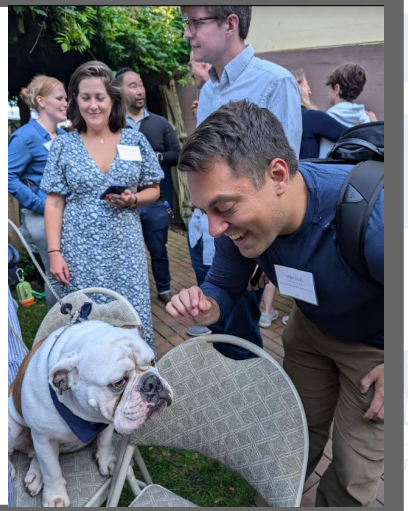
Harvard Extension School
HARVARD DIVISION OF CONTINUING EDUCATION

OREGON HEALTH & SCIENCE UNIVERSITY
OHSU

BOSTON MEDICAL CENTER
EXCEPTIONAL CARE. WITHOUT EXCEPTION.

About Me (5/5)

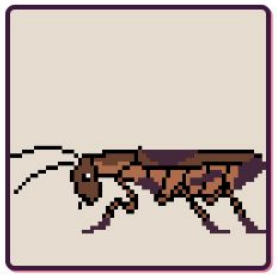
Yale



https://amoriem-labs.github.io/

Marvin Chun's Kick

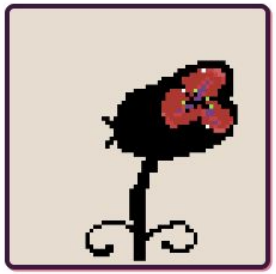
Peter Salovey's Punch



Dirt Roach

Fireball Bee

Guardian Tree



Jupiter Trap

Locust

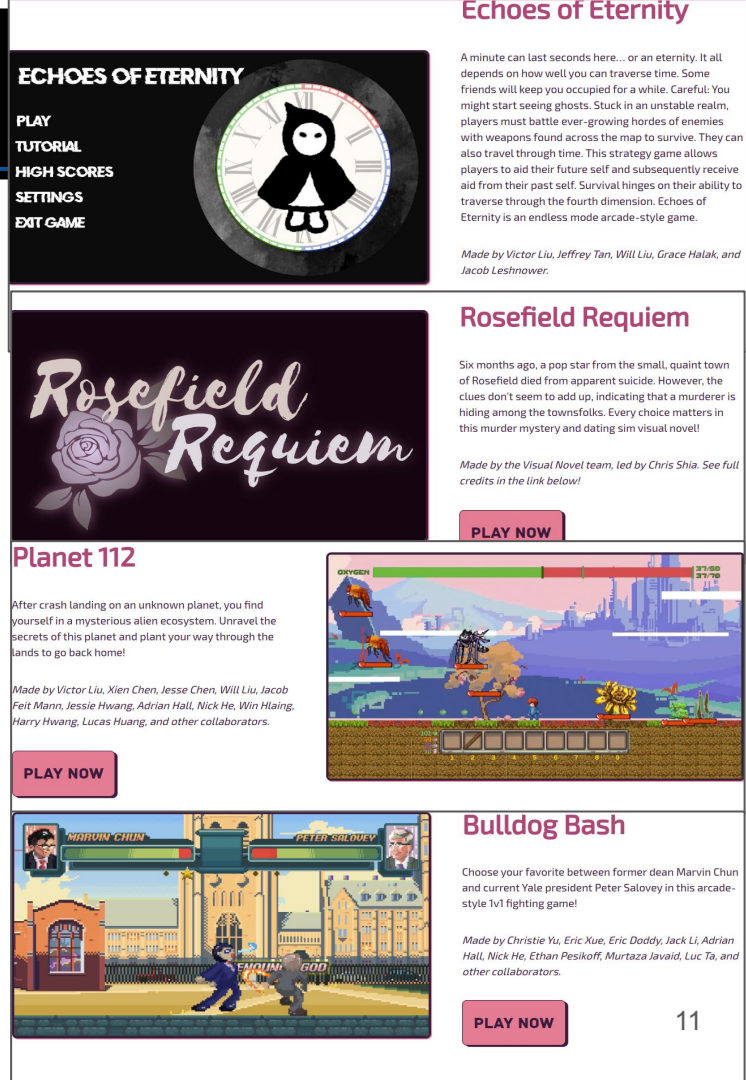
Pitcher Plant

Tartarus's Eye

Titan Beetle

Amoriem Labs Advice

- Many of you are already making games which is awesome!
- **The only piece of advice** I need you to take today is -- **keep participating in the process of making games.**
  - Hackathon?
  - Game Jam
  - 4 hour speed development run on a weekend?
  - Long plane ride? Long train ride? Make a game
    - (It's a thing: https://trainjam.com/)
  - Keep doing it!
    - Those little experiences add up to big experiences over time!



What Goes into Game Development?

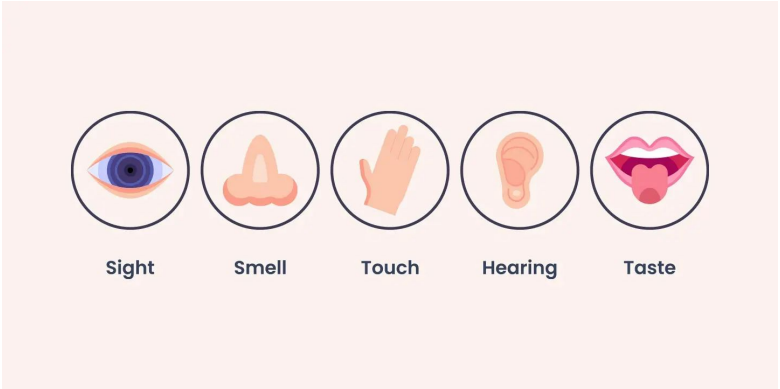
Exercise: What do you see here?

Exercise: What do you see here?

- How about now?

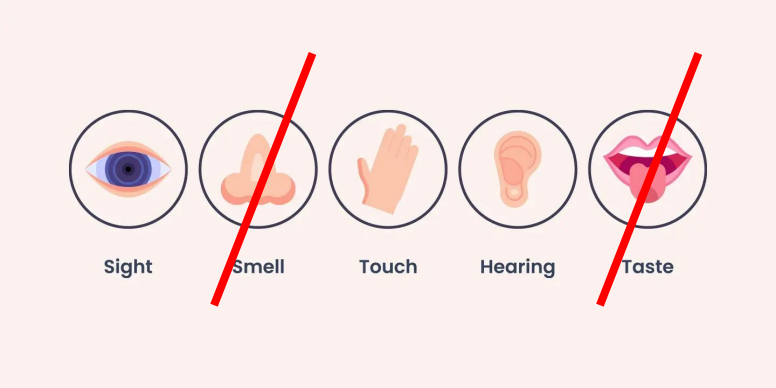
Exercise: What do you see hear?

- And now?
- (Play audio clip)
  - https://www.youtube.com/watch?v=J_gEzOZKyE4



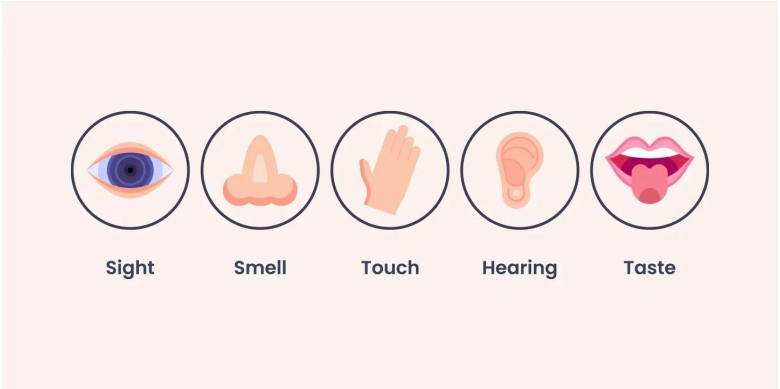
The Five Senses

Skills for various roles in game development



The ~~Five~~ Three Senses

Skills for various roles in game development



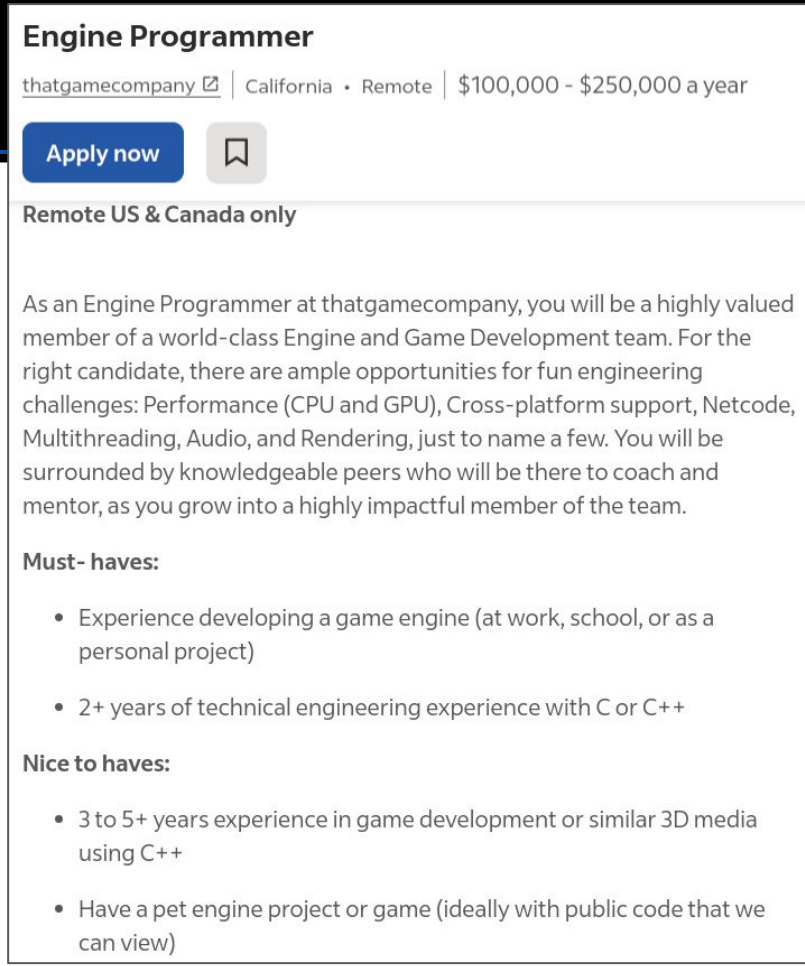
Visual

(Art and Coding Side of Game Development)

https://redcliffelabs.com/myhealth/_next/image/?url=https%3A%2F%2Fmyhealth-redcliffelabs.redcliffelabs.com%2Fmedia%2Fblogcard-images%2F3357%2Fa7255361-1158-4a71-8f5a-2ebfcb776cd5.jpg&w=1920&q=75

Engine Programmers

- Did you enjoy computer systems or software engineering?
  - Work on the engine of a game and build the ‘engine’ that ties everything together
  - May involve specialization in some skills (e.g. networking, graphics, 3D Math), but otherwise good skills in architecture.
- Obvious candidates:
  - Can go work on Unreal Engine, Unity3D, etc.
  - Many companies have in-house engines or tooling still
- Nice resource on engine programming
  - https://engine-programming.github.io/



Engine Programmer

thatgamecompany | California • Remote | $100,000 - $250,000 a year

Apply now

Remote US & Canada only

As an Engine Programmer at thatgamecompany, you will be a highly valued member of a world-class Engine and Game Development team. For the right candidate, there are ample opportunities for fun engineering challenges: Performance (CPU and GPU), Cross-platform support, Netcode, Multithreading, Audio, and Rendering, just to name a few. You will be surrounded by knowledgeable peers who will be there to coach and mentor, as you grow into a highly impactful member of the team.

Must- haves:

- Experience developing a game engine (at work, school, or as a personal project)
- 2+ years of technical engineering experience with C or C++

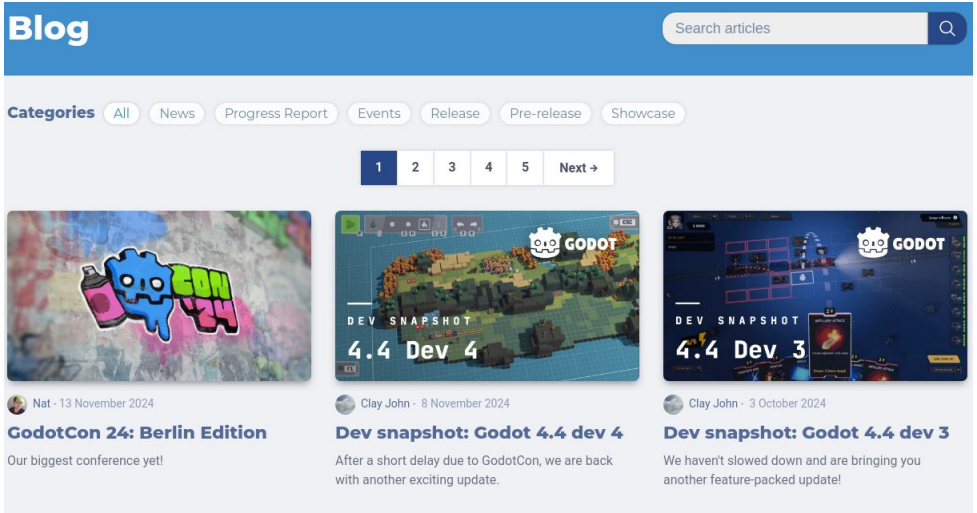
Nice to haves:

- 3 to 5+ years experience in game development or similar 3D media using C++
- Have a pet engine project or game (ideally with public code that we can view)

https://www.indeed.com/q-game-engine-programmer-jobs.html?vjk=efc75d32c6970ba5

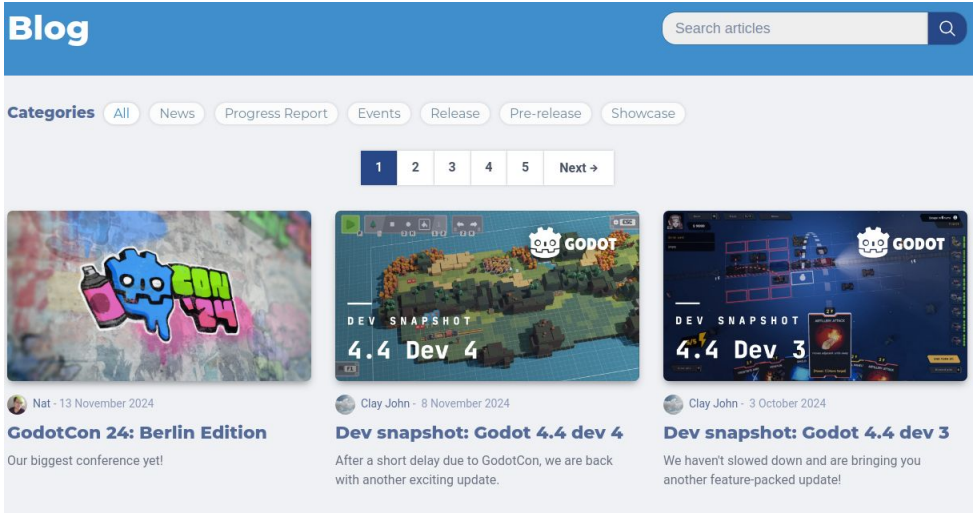
A Deeper Look at Engine Programming (1/5)

- Let’s take a look at the GoDot engine for instance
- Pretend you are the ‘engine programmer’ for the project
  - https://godotengine.org/blog/



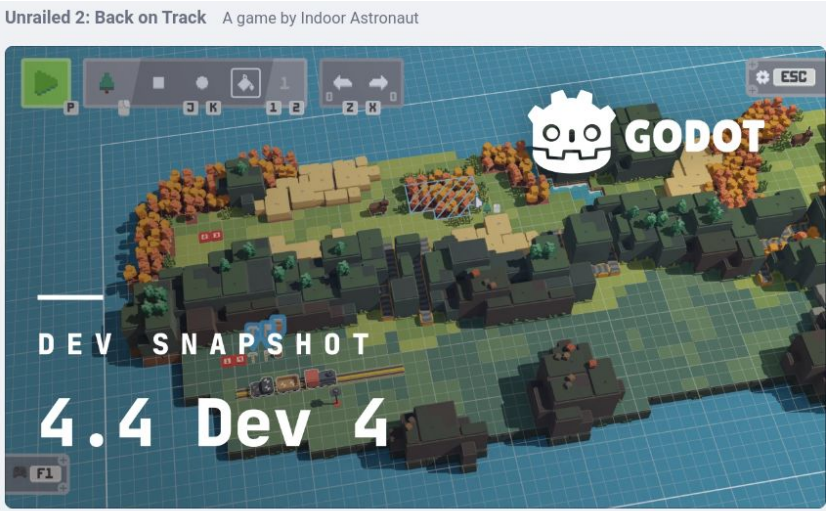
A Deeper Look at Engine Programming (2/5)

- A good exercise you can do for any position we talk about today, is find a project you like -- then try to find the:
  - Developer blog
  - YouTube/Twitch Stream
  - Github Repository
- Then try to follow some of the ‘changes’ and ‘tasks’ they are doing.
  - Perhaps i may make ‘more real’ the work and expectations of each job that you’re working on.



A Deeper Look at Engine Programming (3/5)

- Example of a recent blog entry:
  - https://godotengine.org/article/dev-snapshot-godot-4-4-dev-4/



Dev snapshot: Godot 4.4 dev 4

By: Clay John 8 November 2024

Pre-release

We are back roughly a month after the release of dev3 to bring you a host of new improvements. Many of our developers traveled to Germany in October for GodotCon and the yearly Godot contributor meeting. There they spent two days discussing some of the biggest technical challenges and puzzling out solutions

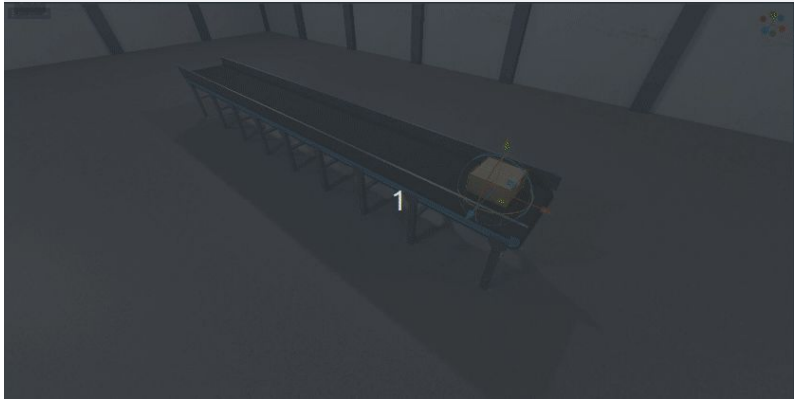
A Deeper Look at Engine Programming (4/5)

- Here’s the feature highlighted

Use collision detection ray to reposition an object already in the scene

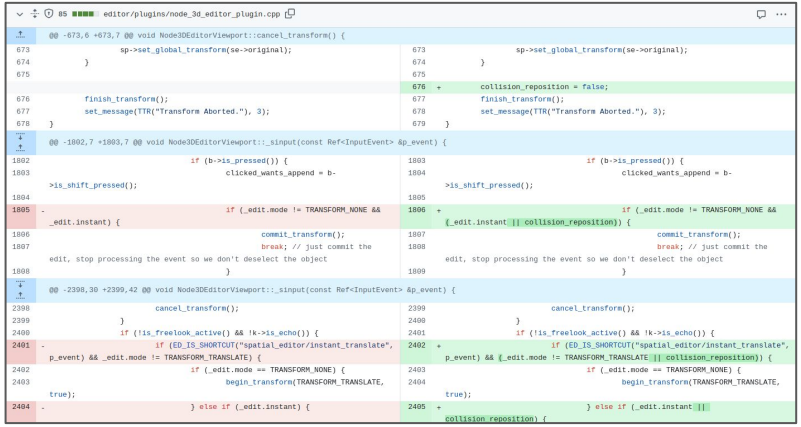
ryevdokimov added object snapping for placing 3D objects in the editor (GH-96740).

This is not a drill, see below.



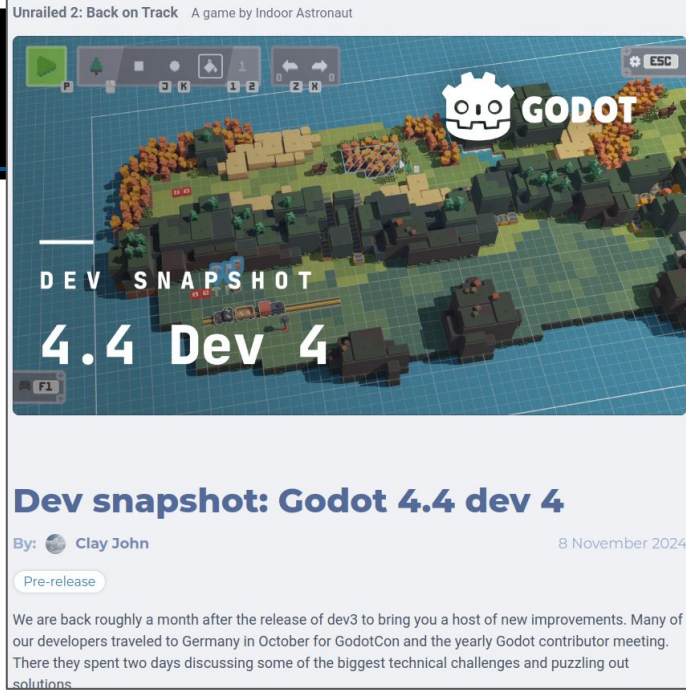
A Deeper Look at Engine Programming (

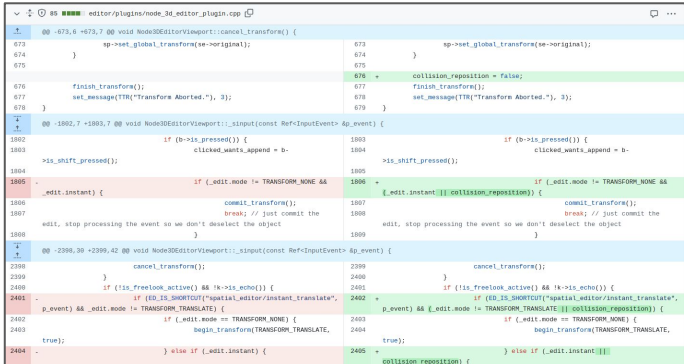
- Here's the pull request (i.e. update to the code)
  - https://github.com/godotengine/godot/pull/96740
- You can click 'commits' to then see the code changes
  - https://github.com/godotengine/godot/pull/96740/commits/fb768a7118dd291258bba061febde7cdc8ed6f5d



Engine Programming Review

- If you’re a bit more senior in your game programming career, you’ll get more out of this little exercise.
  - But what I want to demonstrate is, that the ‘**truth**’ about how to develop games can always be found in the source code.
  - **Reading code** is extremely important -- and it **will save you time** in the long term.





Graphics Programmers

- Use 3D math and graphics APIs to support artists
  - Your job is to make things draw fast, and support artists get their work in the game
  - Generally own the software architecture in regards to how things are drawn.
- Graphics programming skills are highly transferable
  - To other adjacent industries (semiconductors,
- https://www.rockstargames.com/careers/openings/position/6250336003

WHAT WE DO

- We develop cutting-edge graphics and visual effect systems, working together with other departments to create optimal, attractive solutions for our games.

RESPONSIBILITIES

- Develop new and enhance existing graphics technologies (rendering, lighting, shadows, shaders, culling, scene management and others) to help achieve state-of-the-art visuals.
- Work closely with the rest of the programming team to assist in integrating graphics technologies, identify extensions to that technology, and help create those improvements.
- Occasional mentoring of more junior members of the team.

QUALIFICATIONS

- A degree in Computer Science / related discipline or equivalent experience.
- 1+ years of PC or console graphics development experience.

SKILLS

- Experience with C/C++ programming
- Experience with HLSL or other vendor specific shader programming language.
- Experience with 3D graphics APIs (Direct3D 11+, OpenGL, Vulkan and/or vendor specific).
- Experience optimizing both performance factors and memory footprints using hardware and software profilers

Tools Programmers

- A happy medium in a way between a graphics / engine programmer.
- May own some part of the software tool stack -- usually independent and smaller in scope.
- Might support the ‘art’ pipeline (e.g. creating tools in Blender3D, Maya3D, etc.)
- You are seen as someone who ‘saves the day’ building tools to make someone else's life easier.
- Check out:
  - https://thetoolsmiths.org/

WHAT WE DO

- We create technology, tools, and solutions to enhance the creator experience and empower our community to create and share any experience imaginable.
- We deliver a technology platform that enables creators to develop their own game modes and other modifications in a variety of scripting languages and for players to experience this content on fully customized dedicated servers.

RESPONSIBILITIES

- Work with the Tools team on a wide range of areas in an established codebase, such as our asset pipeline, automated systems or standalone user-interfaces.
- Collaborate with artists, programmers and designers, collating requirements and developing solutions to the technical challenges faced when building community-facing developer tools.
- Improve workflow and user experience.
- Maintaining and fixing bugs in the toolchain.
- Working within a schedule to deliver features and fixes effectively to deadlines.

https://www.rockstargames.com/careers/openings/position/6222935002

UI Programmer

- You build what game players will interact with.
  - May also involve ‘user studies’ to see what is optimal / least frustrating for game developers at every corner of the game.
  - Could additionally build SDKs that other tool programmers use.

WHAT WE DO

The UI Team at Rockstar is a diverse, multinational team made up of programmers and developers from across our studios.

Working together across time zones we use our industry-leading, in-house proprietary “RAGE” engine to produce the User Interface features that form the connection between the player and our games.

We develop our own UI tools, editors and technologies to let our UI developers realise the creative vision of the projects we work on while constantly striving for excellence to produce the seamless UI experience our millions of players expect.

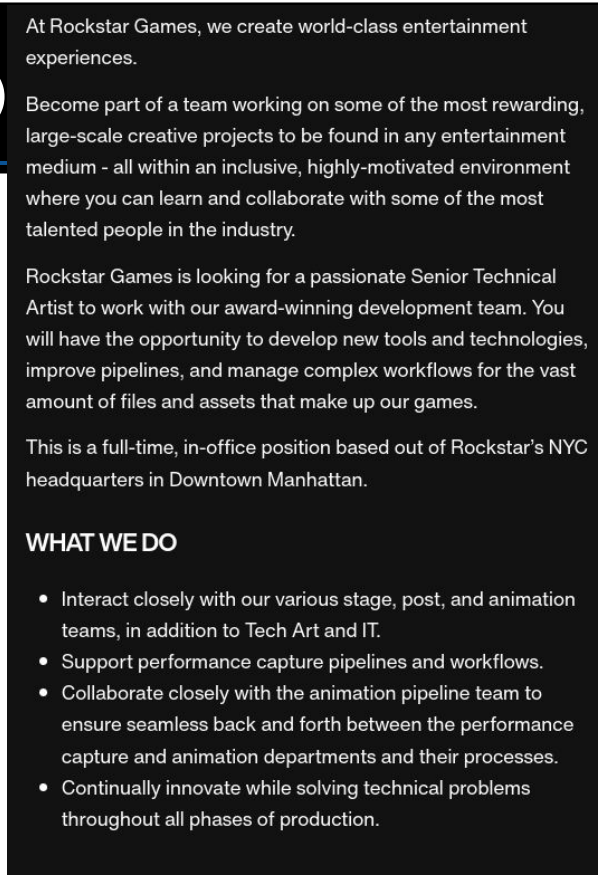
RESPONSIBILITIES

- As a UI programmer, you will work across all areas of UI code development delivering technology updates and game feature code.
- Working with your lead, you will be given both feature areas you will be responsible for and sets of tasks to support other feature areas.

https://www.rockstargames.com/careers/openings/position/5971779003

Tech Artists (Programmers + Artists)

- You do ‘everything’ effectively.
- Tech artists can:
  - Program
  - Do Art
- Often time the job is made up as you go
  - If you enjoy many aspects of game development, this is probably the type of role you want to secure.
- https://www.rockstargames.com/careers/openings/position/6085095003



At Rockstar Games, we create world-class entertainment experiences.

Become part of a team working on some of the most rewarding, large-scale creative projects to be found in any entertainment medium - all within an inclusive, highly-motivated environment where you can learn and collaborate with some of the most talented people in the industry.

Rockstar Games is looking for a passionate Senior Technical Artist to work with our award-winning development team. You will have the opportunity to develop new tools and technologies, improve pipelines, and manage complex workflows for the vast amount of files and assets that make up our games.

This is a full-time, in-office position based out of Rockstar’s NYC headquarters in Downtown Manhattan.

WHAT WE DO

- Interact closely with our various stage, post, and animation teams, in addition to Tech Art and IT.
- Support performance capture pipelines and workflows.
- Collaborate closely with the animation pipeline team to ensure seamless back and forth between the performance capture and animation departments and their processes.
- Continually innovate while solving technical problems throughout all phases of production.

Artists (2D Concept Artists)

- Sketch out in 2D what artists will produce in 2D or 3D later
  - Use your imagination -- usually no real limitations technology wise
  - However -- might think of some constraints of perspective, color palette choices, etc. that are in the game.
- Related positions
  - Texture Artist
- https://www.indeed.com/q-2d-concept-artist-jobs.html?vjk=4977283366b38502

Advanced Concept Artist

Warner Bros. Discovery | Salt Lake City, UT 84111

You must create an Indeed account before continuing to the company website to apply

Apply now

Avalanche Software, a division of Warner Brothers Games Inc. seeks an Advanced Concept Artist. Join the team who created Hogwarts Legacy, a new open world, action RPG set in the Wizarding World.

The Daily

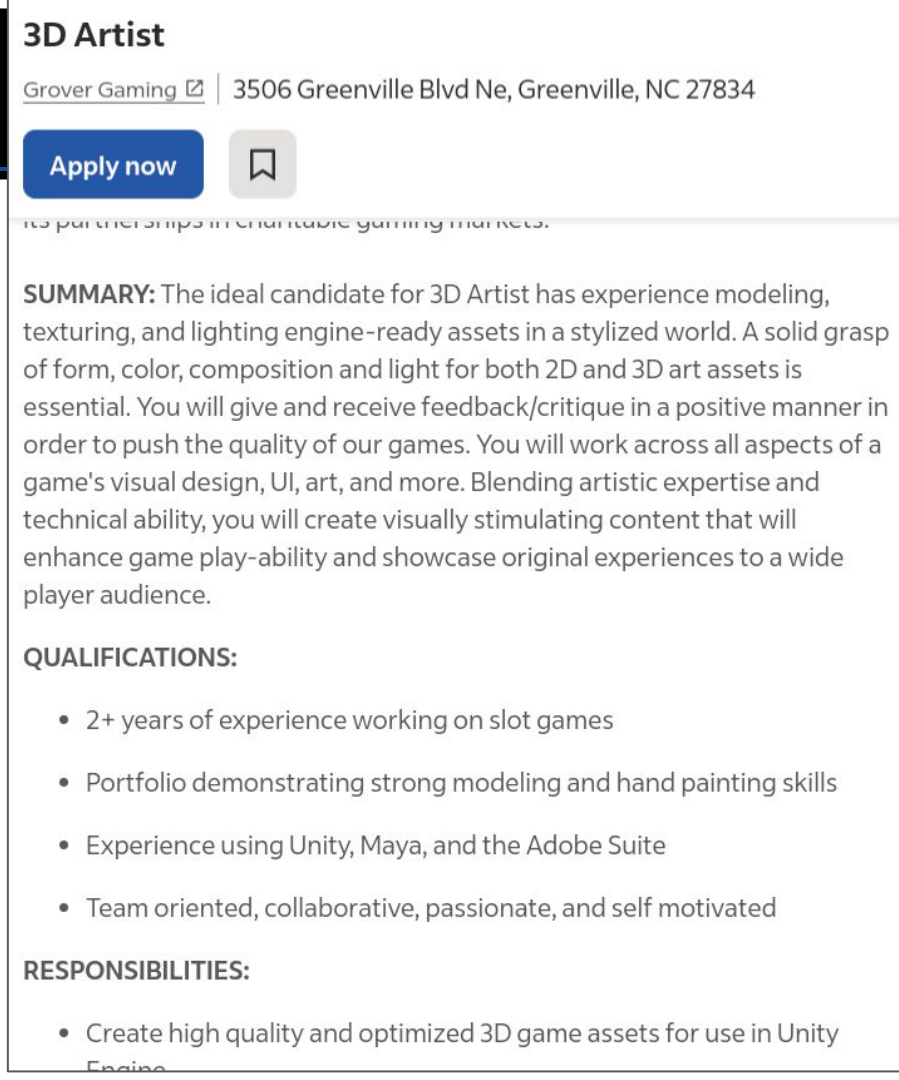
- Create and iterate characters, enemies and environment art and designs
- Create sketches and detailed renderings of props and individual environmental elements, detailed renderings and turnarounds for characters, creatures, enemies
- Collaborate on the visual style to ensure high quality

The Essentials

- At least 8 years of progressively complex industry experience or a combination of experience with a BA in art or related field
- Strong ability to collaborate and mentor junior artists
- Advanced, in-depth knowledge and exceptional foundation art skills
- Strong understanding of human and animal anatomy with an ability to render realistic concepts
- Strong understanding of costume design throughout human history
- Solid understanding of geography, geology, terrain, flora with an

3D Artists

- Build the 3D art in studios tool
  - Typically in the same pipeline (e.g. Maya, Blender3D, etc.) other artists use, but not always.
    - May involve using several tools.
    - May involve reviewing other artists work for ‘fit’ style
    - Will need to learn some sort of ‘asset management’ software.
- https://www.indeed.com/jobs?q=3d+game+art&l=&from=searchOnDesktopSerp&vjk=a0e886c0e4f23084



3D Artist

Grover Gaming | 3506 Greenville Blvd Ne, Greenville, NC 27834

Apply now

SUMMARY: The ideal candidate for 3D Artist has experience modeling, texturing, and lighting engine-ready assets in a stylized world. A solid grasp of form, color, composition and light for both 2D and 3D art assets is essential. You will give and receive feedback/critique in a positive manner in order to push the quality of our games. You will work across all aspects of a game's visual design, UI, art, and more. Blending artistic expertise and technical ability, you will create visually stimulating content that will enhance game play-ability and showcase original experiences to a wide player audience.

QUALIFICATIONS:

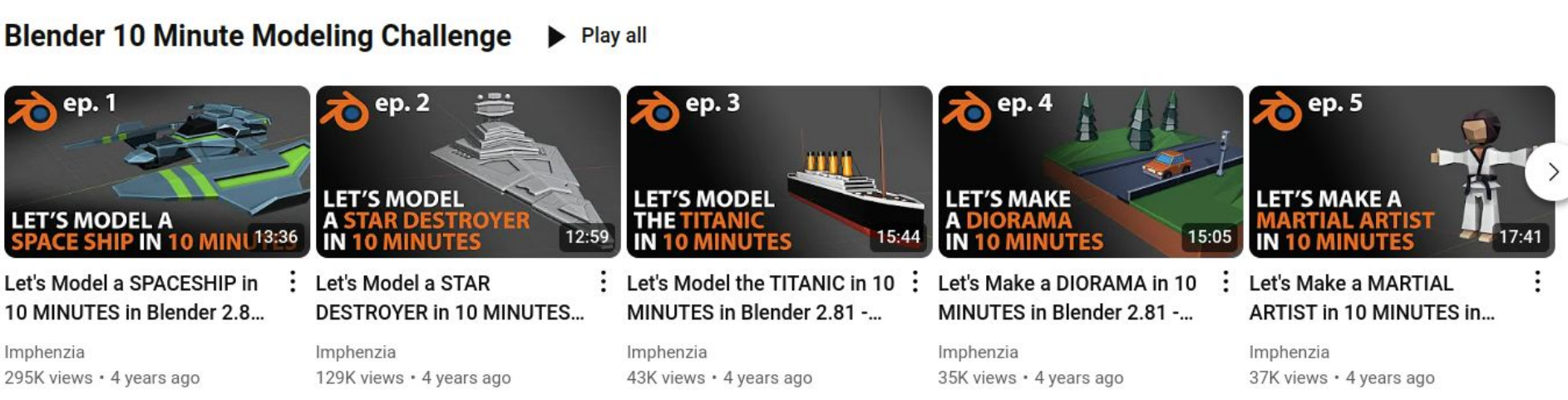
- 2+ years of experience working on slot games
- Portfolio demonstrating strong modeling and hand painting skills
- Experience using Unity, Maya, and the Adobe Suite
- Team oriented, collaborative, passionate, and self motivated

RESPONSIBILITIES:

- Create high quality and optimized 3D game assets for use in Unity

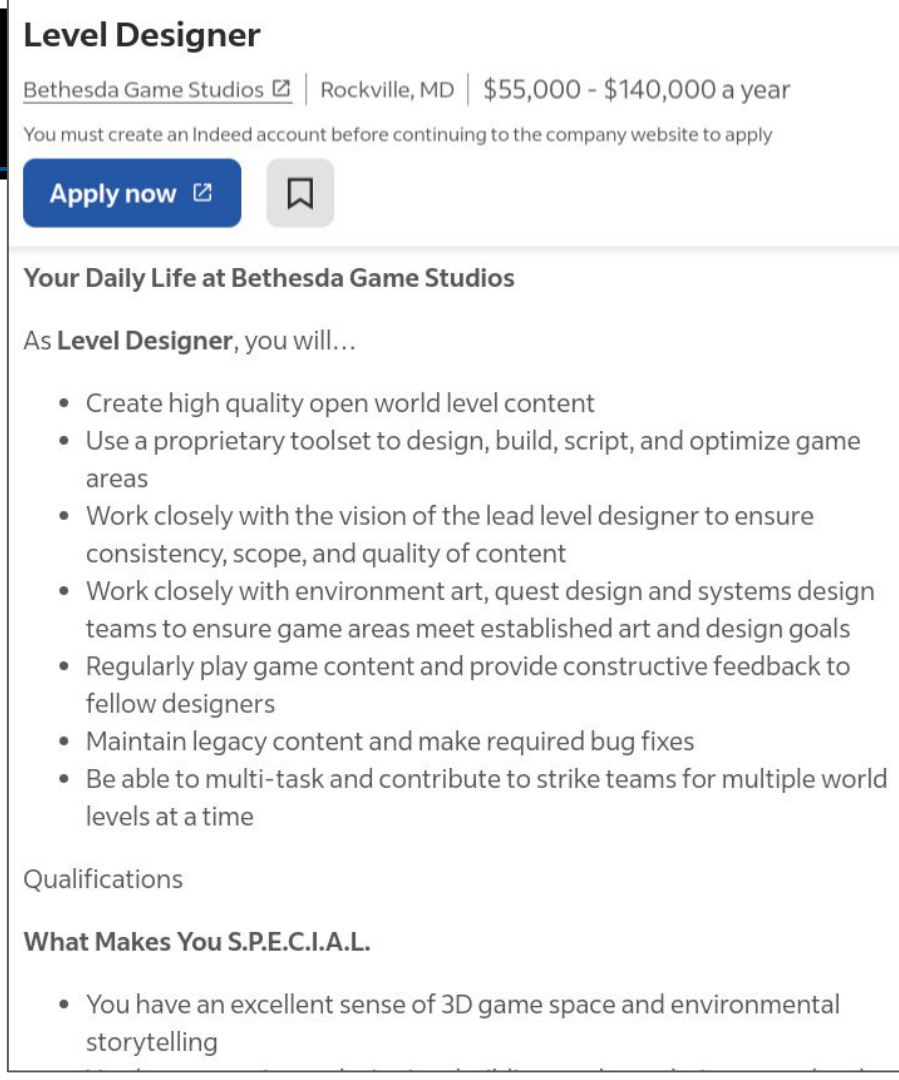
3D Artist Deep(er) Dive

- I recommend you otherwise watch what other artists are doing
  - ‘speed run’ tutorials are a great way to pick up some tricks.
  - I also try to follow along or replicate what I see.
    - A little bit of practice regularly adds up to big gains!
- https://www.youtube.com/@Imphenzia



Level Designers / Environment Artists

- You design the levels by putting together 3D art.
  - May involve just ‘blocking out’ the level as a draft, and then slowly filling in the details.
- May involve some amount of programming as well
  - e.g. setting up ‘triggers’ or events that occur.
- https://www.indeed.com/q-video-game-level-designer-jobs.html?vjk=09a9324d6ca6edff



Level Designer

Bethesda Game Studios | Rockville, MD | $55,000 - $140,000 a year

You must create an Indeed account before continuing to the company website to apply

Apply now

Your Daily Life at Bethesda Game Studios

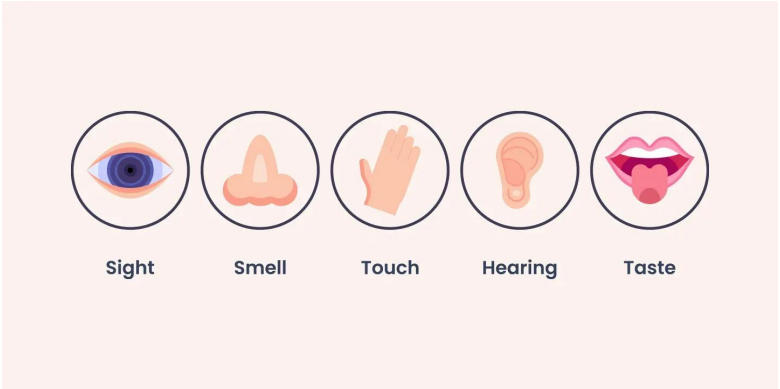
As **Level Designer**, you will…

- Create high quality open world level content
- Use a proprietary toolset to design, build, script, and optimize game areas
- Work closely with the vision of the lead level designer to ensure consistency, scope, and quality of content
- Work closely with environment art, quest design and systems design teams to ensure game areas meet established art and design goals
- Regularly play game content and provide constructive feedback to fellow designers
- Maintain legacy content and make required bug fixes
- Be able to multi-task and contribute to strike teams for multiple world levels at a time

Qualifications

What Makes You S.P.E.C.I.A.L.

- You have an excellent sense of 3D game space and environmental storytelling



Audio

(Recording, Programming, level design, plugin making)

Musicians / Composer

- Build original sound tracks for games
  - Could involve working in a physical studio for AAA games.
  - Can sometimes involve finding other musicians, singers, etc. to work with.
  - Might also involve recording of ‘voices’ for voice actors.
- https://www.indeed.com/q-Video-Game-Sound-Designer-jobs.html?vjk=22ba75aefb7d7c28

Composer/Sound Designer

Grover Gaming | 3506 Greenville Blvd Ne, Greenville, NC 27834

Apply now

SUMMARY: Grover Gaming is looking for a talented and self-sufficient full-time composer/sound designer to be a part of an innovative and highly collaborative team of artists, game programmers, and other audio professionals. Our goal is to provide entertaining gaming experiences for the video slots and casino market. The Composer/Sound Designer should not only have the necessary experience, but also the drive and passion to create fun, exhilarating audio for our games.

QUALIFICATIONS: To perform this job successfully, an individual must be able to perform each essential duty satisfactorily. The requirements listed below are representative of the knowledge, skill, and/or ability required. Reasonable accommodations may be made to enable individuals with disabilities to perform the essential functions.

RESPONSIBILITIES:
Understand company Mission, Vision, and Values and be an ambassador of MVV.

- Compose, arrange, and produce original full-length tracks to reflect and enhance any given game theme.
- Design sound effects that enhance gameplay, help provide clarity for in-game features, and grab a player’s attention.

Audio / Sound Engineers

- Placing sounds in 2D/3D environment
  - Can involve mixing/sampling sounds to create various effects.
- Can also involve programming tools.
  - In some cases, building audio APIs
- https://www.indeed.com/jobs?q=audio+game+programmer&l=&from=searchOnDesktopSerp&vjk=224b04f8f9a691e1

Senior Audio Programmer

Epic Games | Boston, MA

You must create an Indeed account before continuing to the company website to apply

Apply now

We're looking for a programmer passionate about audio, and specifically music, for the Audio Gameplay Engineering team, which operates across all of Epic's first-party products, including Unreal Engine, Fortnite, Rocket League, special demos, and more. In this role, you will explore and unlock the future of interactive music creation by developing low-level technologies and high-level tools that allow seasoned game developers, trained composers/musicians, hobbyist creators, and average gamers to create compelling musical content and experiences. You'll work in collaboration with the Unreal Engine Audio team, Music Content Designers, and Technical Music Designers. Our ideal candidate would be able to draw on a deep knowledge of computer music systems, MIDI, digital signal processing (including synthesis), audio plugins for digital audio workstations, and have experience working in the video game industry, perhaps as an audio programmer on a game team. But even if you can only check a few of those boxes, we want to hear from you! If you are passionate about music and gaming, and are interested in empowering both your fellow devs and end users with tools that allow them to create amazing, interactive, musical experiences, you are the ideal candidate. Come join the team at Epic and let's build awesome music tech!

In this role, you will

Game Design

(Art and Coding Side of Game Development)

Gameplay Programmers

- Make the game come alive!
- Your job is to build fun experiences with the team -- often scripting events, boss battles, puzzles, etc. within the game.

Game Systems Engineer

At Rockstar Games, we create world-class entertainment experiences.

Become part of a team working on some of the most rewarding, large-scale creative projects to be found in any entertainment medium - all within an inclusive, highly-motivated environment where you can learn and collaborate with some of the most talented people in the industry.

Rockstar Dundee is looking for talented developers whose skill set combines technical excellence with a passion for making games. As part of the Design/Scripting team you will be developing script framework and coding gameplay systems. You will be required to engage with a range of classic game programming areas such as AI, physics, animation, UI, and data management among others.

https://www.rockstargames.com/careers/openings/position/5974912003

Game Designer

- Figure out the ‘roles of the game’ and ‘game mechanics’
  - Depending on position can also involve programming (overlapping with previous game systems engineer responsibilities)
- https://www.indeed.com/jobs?q=game+designer&l=&from=searchOnDesktopSerp&vjk=4330a2b4dfb88ff9

Game Designer

InvinciblegG | Washington, DC | $20 - $50 an hour

Apply now

Responsibilities:

Oversee the areas of development as it pertains to the design team

Lead the supporting game designers through mentorship and growth

Transform conceptual ideas into fully fleshed out designs with the design team

Maintain centralized documentation on all areas of the game

Collaborate with other members of leadership on all aspects of the game's development

Conceptualize, implement, and balance game content through industry-standard tools

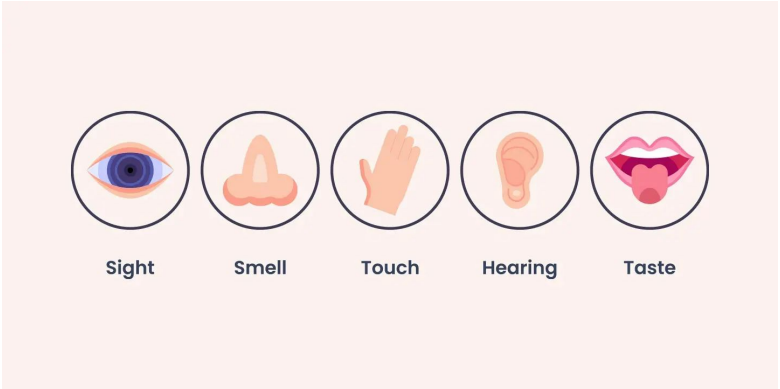
Use various tools for rapid data-driven feature iteration

Scripting of game content through popular languages

Work (and collaborate) with other teams to develop content and features

Management of design staff (performance reviews, regular check-ins, etc.)

Transfer the all-inclusive creative vision and concise feature requirements



Touch

(Production, Specialized Devices)

Production

- Your ‘hands on’ in keeping everything together
  - Often managing a ‘JIRA’ (task management software) of who is doing what at all times.
  - Goal is to keep folks on task, unblocked, and able to make forward progress.
- Manage resources during development of game
  - i.e.
    - People
    - Money
    - Time
- https://www.indeed.com/jobs?q=game+producer&l=&from=searchOnDesktopSerp&vjk=3dbd42b36fc0c5f1

Associate Producer

OtherSide Entertainment | Concord, MA • Remote | $60,000 - $80,000 a year

You must create an Indeed account before continuing to the company website to apply

Apply now

- Maintain Project Documentation: Keep Jira projects, task boards, and Confluence documentation organized and up to date, ensuring all team members have the latest information.
- Assist Feature Lane Development: Work closely with feature leads to track progress and ensure that development stays on schedule. Follow up on tasks and milestones to prevent delays.
- Identify Risks and Red Flags: Proactively recognize issues and risks that may impact the project timeline or quality, and flag them for the production team.
- Ask the Right Questions: Keep things moving by asking necessary questions when tasks are unclear, dependencies are blocked, or risks are identified, ensuring smooth communication across teams.
- Support Daily Operations: Assist in tracking team progress, ensuring tasks are completed on time, and coordinating with cross-functional teams to remove blockers.
- Contribute to Sprint Planning: Help organize and execute sprint plans by supporting backlog prioritization, scheduling, and sprint reviews.

Qualifications

- 2-3 years of experience in a game production role or supporting feature development, including task tracking and team coordination.

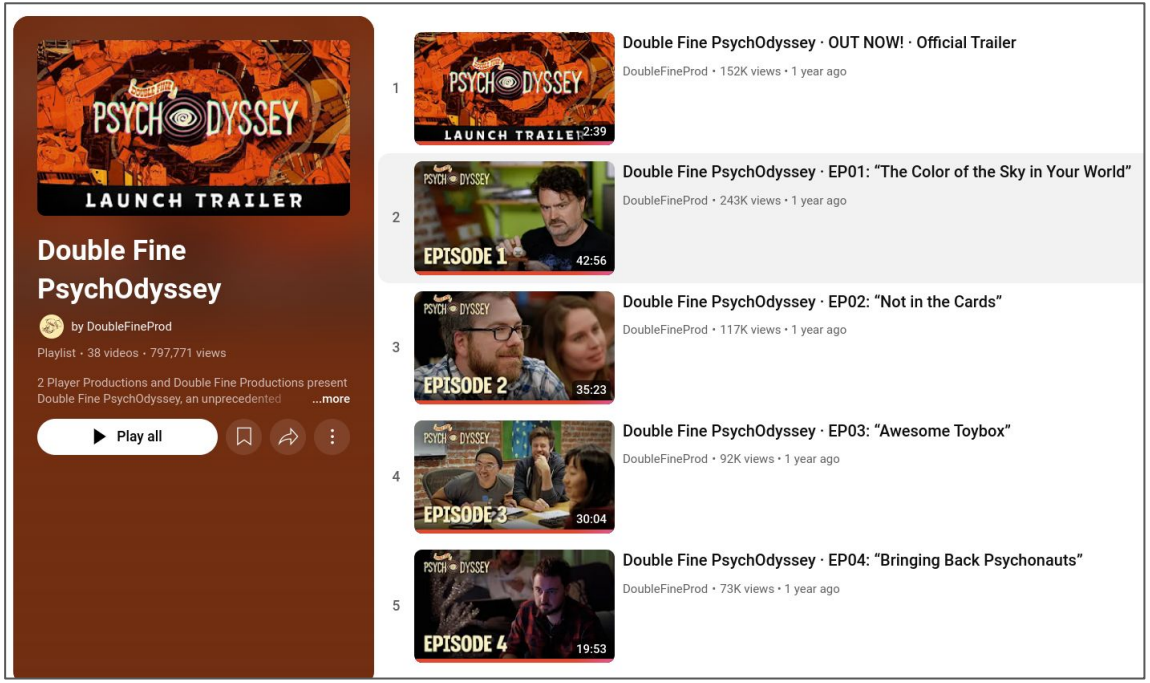
Documentaries on Game Development

The Good News...

- These days you can literally watch a ‘streamer’ on YouTube and/or Twitch and see every step of the process.
- The tricky thing however is to make sure that you spend equal (or more) amount of time actually building something yourself.

Psych Odyssey (Double Fine)

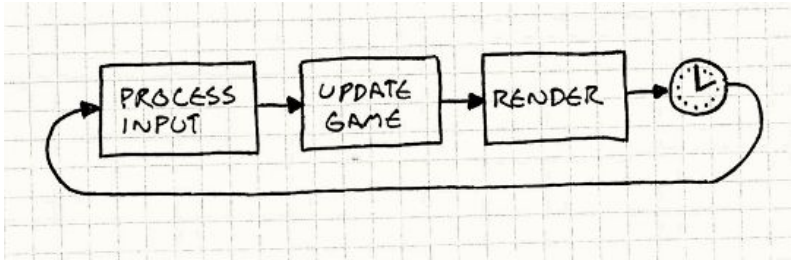
- Full 30+ episode documentary covering multiple games
  - Better than anything you'll find on Netflix!
- https://www.youtube.com/playlist?list=PLIhLvue17Sd70y34zh2erWWpMyOnh4UN



Courses at Yale

CPSC 411 / 511 - Building Game Engines

- **Taught**:
  - Fall and Spring
- **Goal:**
  - Build a ‘game framework’ and ultimately a game.
- **Unlocks later in the curriculum**:
  - CPSC 409 / 511 - Real-Time 3D Computer Graphics Programming
- **Recommendation(s):**
  - Recommended to take this semester right after CPSC 323
    - Useful to start building your portfolio for game industry internships asap.
  - Recommended you take 409 / 509 immediately after for continuity of building games (but in 409 / 509 in 3D).



CPSC 409 / 509 - Real-Time 3D Computer Graphics Programming

- **Taught:**
  - Spring
- **Goal:**
  - Build 3D games using a hardware accelerated graphics (GPU) with an API like OpenGL
- **Unlocks later in the curriculum:**
  - N/A
- **Recommendation(s):**
  - Take this after ‘Building Game Engines’ or ‘Computer Graphics’
    - Continuity in using the D language
    - Ultimately ‘build a game’ or ‘graphics tech demo’ at the end that runs in real-time.

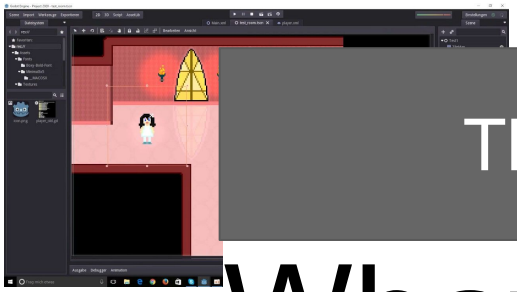
Gamedev.tv

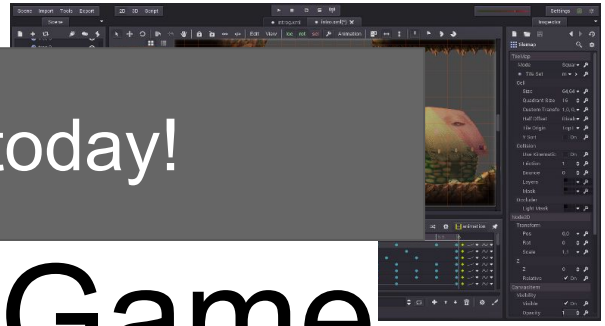
- If you want to learn one of the main engines (Unity3D or Unreal), I recommend taking a look at
  - https://www.gamedev.tv/
  - or otherwise insert_favorite_youtuber_here

On Soft Skills

Soft Skills -- Be nice

- The game industry is a small place
- Your goal should be to help enable folks do their job easier
  - People will like working with you
  - Think about ‘how can I enable others to make their life easier’
    - Sometimes that is as simple as getting your own work done.
    - Often it can be to also ‘ask’ and ‘communicate’ with others.
      - Make others feel included as they should be!
- How to practice?
  - In your group projects -- be respectful and responsive
  - 15+ years later, and I’m still friends with many folks in college who went on to work in the game industry
    - I just always tried to be helpful.

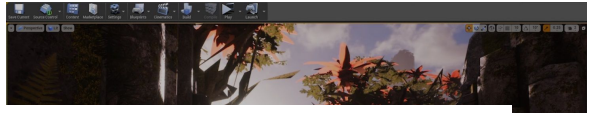
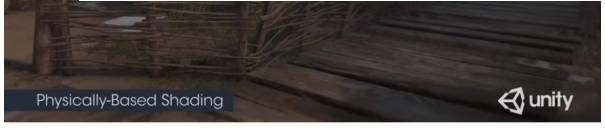
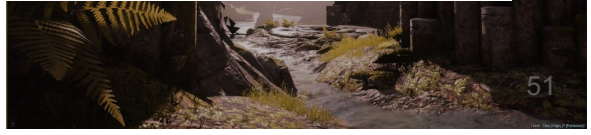




Thank you for inviting me today!

What goes into a Game during Game Development?

Dr. Mike Shah
http://www.mshah.io



A presentation on roles and life as a game developer